ultrasound transducer **14**, a gaseous coupling fluid **16** and a resin **18** (shown generally as a block). The resin **18** may be positioned in the reaction vessel **12** and the reaction vessel **12** may be positioned in the gaseous coupling fluid **16** such that ultrasonic energy may pass from the ultrasound transducer **14**, through the gaseous coupling fluid **16** and to the resin **18** in the reaction vessel **12**, thereby curing the resin **12** therein.

The resin **18** may be any synthetic resin capable of being cured upon exposure to ultrasonic energy for a certain amount of time. Optionally, the resin **18** may include a catalyst **20** (shown generally as a block), such as a curing agent or hardener, to facilitate or promote the curing process. In one aspect, the resin **18** may be an epoxy resin. One example of an appropriate epoxy resin is HYSOL® EA 956 epoxy resin available from Henkel Corporation of Bay Point, Calif., which is a two-component epoxy resin (i.e., it includes a catalyst **20**). Another example of an appropriate epoxy resin is EPOFIX resin available from Struers A/S of Ballerup, Denmark, which is a two liquid system that includes both a resin and a hardener (i.e., a catalyst **20**).

Optionally, the resin **18** may be combined with one or more substrates (not shown), such as fibers, glass, metals and wood, to form a composite material. The substrate may be selected based upon the intended use of the composite material. For example, the substrate may be used to reinforce the composite material or may be used to impart certain desired physical properties to the composite material (e.g., thermal conductivity). Those skilled in the art will appreciate that, depending on the desired result and/or the type of substrate used, the substrate may be dispersed in the resin, the resin may impregnate the substrate, or some other resin/substrate configuration may be used.

The gaseous coupling fluid **16** may be any gas capable of acoustically coupling the ultrasound transducer **14** to the reaction vessel **12**, and ultimately to the resin **18** disposed therein. In one particular aspect, the gaseous coupling fluid **16** may be received in a vessel **22**, such as a tank or barrel. For example, the gaseous coupling fluid **16** may be ambient air, nitrogen gas, argon gas or the like. Other examples of useful gaseous coupling fluids **16** will be readily apparent to those skilled in the art.

The temperature and pressure of the gaseous coupling fluid **16**, as well as other physical conditions of the gaseous coupling fluid **16**, may be at ambient conditions (e.g., 25° C. and 1 atm), thereby eliminating the need for ovens, pressure vessels, autoclaves and the like. However, those skilled in the art will appreciate that the physical conditions of the gaseous coupling fluid **16** may be controlled as desired without departing from the scope of the present disclosure. Optionally, the physical conditions of the coupling fluid **16** may be dictated by the type of resin **18** being cured.

The ultrasound transducer **14** may be any device capable of generating ultrasonic energy. In one aspect, the ultrasound transducer **14** may generate ultrasonic energy in the range of about 20 to about 40 kHz. For example, the ultrasound transducer **14** may be of the type found in a common ultrasonic cleaner, such as a typical ultrasonic jewelry cleaner having an integral couplant vessel. In another aspect, the ultrasound transducer **14** may generate ultrasonic energy in excess of 40 kHz.

As shown in FIG. **1**, the ultrasound transducer **14** may be in direct acoustical contact with the gaseous coupling fluid **16**. For example, the ultrasound transducer **14** may be an ultrasonic horn (e.g., a titanium horn) that has been directly immersed in the gaseous gaseous coupling fluid **16**. Alternatively, an intermediate coupling agent may be disposed between the ultrasound transducer **14** and the gaseous coupling fluid **16**.

The reaction vessel **12** may be any appropriate vessel capable of transmitting ultrasonic energy from the gaseous coupling fluid **16** to the resin **18** received therein, while essentially isolating the resin **18** from the gaseous coupling fluid **16**. In one exemplary aspect, the reaction vessel **12** may be a vacuum bag, wherein the resin **18** may be received in the vacuum bag and ambient air may be evacuated from the vacuum bag.

Optionally, as shown in FIG. **1**, a mold **24**, such as a two-piece or two-sided mold, may be positioned in the reaction vessel **12** with the resin **18**. Then, by drawing a vacuum in the reaction vessel **12**, the resin **18** may be urged into the mold **24** and, when cured, may conform to the shape of the mold **24**. Those skilled in the art will appreciate the techniques other than vacuum molding may also be used with the apparatus **10** without departing from the scope of the present disclosure.

Referring now to FIGS. **1** and **2**, one aspect of the disclosed method for curing resin, generally designated **100**, begins at block **102** by placing the resin **18** into the reaction vessel **12** (e.g., a vacuum bag). Optionally, the resin **18** may be premixed with a catalyst **20** or the catalyst **20** may be introduced separately and mixed in the reaction vessel **12**. If the resin **18** is to be molded, a mold **24** may be placed in the reaction vessel **12**, as shown in block **104**. Then, a vacuum may be drawn in the reaction vessel **12** (block **106**) and the reaction vessel **12** may be sealed (block **108**) to maintain the vacuum. As shown in block **110**, the sealed reaction vessel **12** may be positioned (e.g., immersed or supported by a structure) in the gaseous coupling fluid **16** and the ultrasound transducer **14** may be actuated (block **112**) to apply ultrasonic energy to the resin **18** to cure the resin **18**. The application of ultrasonic energy may continue until the resin **18** is completely cured or at least forms a solid mass.

Accordingly, the curing of resins, such as epoxy resins, may be obtained by placing the a resin in an ultrasonic field to receive ultrasonic energy. Of particular interest, a complete resin cure may be obtained faster when ultrasonic energy is used.

Although various aspects of the disclosed method for curing resin have been shown and described, modifications may occur to those skilled in the art upon reading the specification. The present application includes such modifications and is limited only by the scope of the claims.

What is claimed is:

1. A method for processing resin, comprising causing cavitation of a gaseous coupling fluid at ambient temperature and atmospheric pressure in which resin is disposed.

2. The method of claim **1** wherein said causing further comprises applying ultrasonic energy to the coupling fluid.

3. The method of claim **1** wherein said causing further comprises causing cavitation of a coupling fluid including ambient air.

4. The method of claim **1** wherein said causing further comprises causing cavitation of the coupling fluid such that the resin is cured.

5. The method of claim **1** wherein said causing further comprises causing cavitation of the coupling fluid in which resin including a substrate is disposed.

6. The method of claim **5** wherein said causing further comprises causing cavitation of the coupling fluid such that a composite material is formed from the resin.